METHOD OF MANUFACTURING FLOW CONNECTORS HAVING OVERMOLDED INSERTS AND PRODUCT PRODUCED THEREBY

FIELD OF THE INVENTION

This invention generally relates to methods for manufacturing flow connectors and the flow connectors produced thereby and more particularly to a polymer-containing flow connector having flow openings that are formed by overmolding inserts.

DESCRIPTION OF THE PRIOR ART

Fluid handling devices such as diaphragm pumps, for example, include flow connectors or manifolds that are either attached to or integral with a housing and have one to several flow openings or ports being generally formed therein. Generally, an inlet flow opening is provided in an inlet manifold through which a fluid is supplied to the fluid handling device while a discharge flow opening is provided in an outlet manifold through which the fluid is discharged from the device. A flow conduit, such as a pipe, for supplying a fluid to the device is flow connected to the device at the inlet flow opening of the inlet manifold, and a discharge flow conduit for flowing a fluid from the handling device is flow connected to the discharge flow opening of the outlet manifold.

In some applications, these fluid devices are utilized to handle caustic chemicals such as acids, in other applications, comestible substances such as flowable foods and beverages can be pumped. In such applications, the component parts that are to contact the material to be handled are often constructed using materials that resist corrosion and are chemically compatible with the material being handled. In this regard, polymeric materials are often used for various pump components such as the manifolds which can be made using conventional

injection molding techniques. In manifolds having flow openings for threaded installations, however, certain polymeric materials utilized lack material properties for withstanding stresses that may be generated in high pressure fluid handling applications. Moreover, torquing a threaded pipe or flow conduit into such flow openings can also generate stresses that can split the flow opening of a polymeric material.

Although reinforcement rings may be applied to the outside of the flow opening to restrict the expansion of the thread when fluid pressure or torquing stress is applied, the shear strength of the polymer flow opening is still relatively low. While the polymeric material of the manifold may be injection molded over threaded metallic inserts such as stainless steel to increase the thread strength, the torque resistance of the insert against turning in the as-molded manifold is typically poor and therefor prone to leakage between the polymer material and the insert. Moreover, there may also be compatibility issues that arise if the fluid being handled, which is compatible with the polymer material of the manifold, is not compatible with and corrodes or otherwise attacks the metallic material of the insert.

The foregoing illustrates limitations known to exist in present devices and methods. Thus, it is apparent that it would be advantageous to provide an alternative directed to overcoming one or more of the limitations set forth above. Accordingly, a suitable alternative is provided including features more fully disclosed hereinafter.

SUMMARY OF THE INVENTION

According to the present invention, a method of manufacturing a flow connector, the flow connector produced thereby, and an insert incorporated therein are provided. The method comprises providing at least one insert of a composition comprising at least one

polymer and having a threaded bore for attachment to a threaded flow conduit. A composition comprising at least one polymer is molded onto the at least one insert to form a flow connector having a wall thickness defining an internal cavity and comprising at least one aperture defined by the at least one insert through the wall thickness. The insert can also include circumferential grooves and/or spurs located on an exterior surface disposed around the threaded bore and can also comprise one or more reinforcement materials including fiberglass, an inert material, and combinations thereof.

The foregoing and other aspects will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing figures.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. 1 is a front elevational view of an outlet manifold according to the present invention;

FIG. 2 is a front elevational view of an inlet manifold according to the present invention;

FIG. 3 is a top view of an outlet manifold according to the present invention;

FIG. 4 is a top view of an inlet manifold according to the present invention;

FIG. 5 is a sectional view taken along line 5--5 of FIG. 3;

FIG. 6 is a sectional view taken along line 6--6 of FIG. 4;

FIG. 7 is an isometric view of an insert for overmolding into the flow openings of inlet and outlet manifolds according to the present invention;

FIG. 8 is a planar view of the insert shown in FIG. 7; and

FIG. 9 is a sectional side view of the insert taken along line 9--9 of FIG. 8.

DETAILED DESCRIPTION OF THE INVENTION

The invention is best understood by reference to the accompanying drawings in which like reference numbers refer to like parts. It is emphasized that, according to common practice, the various dimensions of the component parts as shown in the drawings are not to scale and have been enlarged for clarity.

Referring now to the drawings, FIGS. 1 and 2 respectively show inlet and outlet flow connectors 40 and 30, respectively, according to the present invention. As used herein, the term "flow connector" includes manifolds, cases, or housings that are particularly useful in the manufacture of fluid handling pumps. For purposes of describing the invention, the connectors will hereinafter be referred to as outlet manifold 30 and inlet manifold 40, which may be attached to or integral with any fluid handling apparatus including any pump or compressor. Such apparatus includes, but is not limited to, a diaphragm pump which operates in a conventional manner well known to one skilled in the art like that shown and described in U.S. Patent No. 5,848,878, the disclosure of which is incorporated herein by reference.

Turning to FIGS. 1-6, manifolds 30 and 40, respectively, comprise manifold bodies 34 and 44 having first ends 36 and 46 and second ends 37 and 47 opposite the first ends. Flow openings 32 and 42 are apertures provided and located between the first and second ends of the manifolds and described in greater detail below. Flow passages 35 and 45, shown in FIGS. 5 and 6, respectively, extend through the manifold bodies and serve to flow connect flow openings 32, 42 with the first and second ends of their respective manifold bodies.

As shown in FIGS. 2 and 4, manifold 40 includes two support feet 49 that are either made integral with or attached to the manifold body. The feet support the fluid pump when

the pump is placed in the environment of use such as on a shelf or shop floor for example.

As shown in FIGS. 1 and 5, outlet manifold 30 includes a check valve housing 39 at each of the discharge manifold ends 36 and 37. Each of the valve housings is adapted to enclose a fluid flow check valve such as a conventional ball-type check valve.

As shown in FIGS. 2, 4, and 6, inlet manifold 40 flow connects, via manifold body 44, the inlet flow opening 42 to openings 48 located in first end 46 and second end 47 which are fluidly connected to a pump housing (not shown) by attachment flanges 41 which are bolted or otherwise connected to the pump housing. In similar fashion, as shown in FIGS. 1, 3, and 5, outlet manifold 30 flow connects, via manifold body 34, the inlet flow opening 32 to check valve housings 39 located in first end 36 and second end 37 which are fluidly connected to a pump housing (not shown) by attachment flanges 31 which are bolted or otherwise connected to the pump housing. An insert 60, having a threaded bore with internal threads 61 for attachment to a threaded flow conduit and described in greater detail below, is overmolded into each of inlet manifold 40 and outlet manifold 30, as shown.

According to the present invention, a method of manufacturing a flow connector, the flow connector produced thereby, and an insert incorporated therein are provided that includes overmolding a polymeric material of the flow connector to be formed onto an insert manufactured of a composition comprising at least one polymer to form a reinforced flow opening in the flow connector. Preferably, the product produced is a manifold construction for fluid handling equipment. More specifically, the manufacturing method incorporates the use of at least one threaded insert which is placed into a mold into which the manifold material is molded, thereby incorporating the threaded insert at one or more flow opening

locations in the flow connector. Preferably, the threaded inserts are made of the same or similar polymer materials as the manifold material to permit a slight remelt to occur between the threaded insert and the manifold to enhance the bond there between and improve torque resistance of the insert while reducing potential leak paths between the insert and the flow connector. A reinforcement material, such as fiberglass, other inert material, or combinations thereof, is also preferred to be included into and, most preferably, oriented circumferentially around the threaded bore of the insert to improve the shear strength of the insert, thereby enabling the threads to withstand high pressures and stresses. By providing a threaded insert that is both reinforced and made of the same or similar polymer as the manifold, the reinforcement material improves the hoop strength of the insert to resist cracking while the elastic nature of the polymer is retained.

Preferably, threaded inserts 60 are designed to include circumferential grooves 62 and/or spurs 64 located on an exterior surface disposed around the threaded bore of the insert as shown in FIGS. 7-9. As shown in FIGS. 5-6, the circumferential grooves 62 permit the formation of in-situ O-rings upon overmolding the manifold material, thereby reducing the possibility of leakage between the threaded insert and the manifold. Also shown in FIGS. 5-6, the spurs 64 act as anchors to enhance the torque and pull-out resistance of the threaded insert in the molded manifold.

The base polymer materials of the manifolds and the threaded insert are preferably made of the same or similar polymer materials that are compatible to permit the remelt and joining between these components. Preferably, thermoplastic materials including, but not limited to, polypropylene (PP) or polyvinylidene fluoride (PVDF), are used which are well-

known and commercially available polymers that may be formed and subsequently molded by a variety of conventional devices and methods, including injection molding, which processes are well known in the art. Briefly, in an injection molding process, the thermoplastic material is generally preheated in a chamber to a temperature at which it will flow and then forced into a relatively cold closed mold cavity by means of high pressure applied through a plunger. A reciprocating screw may be employed to deliver the feed to the mold.

Preferably, threaded inserts according to present invention are incorporated into the flow connectors produced by the manufacturing method disclosed in commonly assigned, concurrently filed, and copending U.S. patent application Attorney Docket No. MBF 010355-9136, the disclosure of which is incorporated herein by reference, by placing the inserts onto core pins of flow openings that are to be threaded prior to injection molding.

While embodiments and applications of this invention have been shown and described, it will be apparent to those skilled in the art that many more modifications are possible without departing from the inventive concepts herein described. For example, although the flow connectors are shown and described as being for useful as manifolds for double diaphragm pumps, it is envisioned that the manufacturing method and products that may produced can include other types of flow connectors for other apparatus. It is understood, therefore, that the invention is capable of modification and therefore is not to be limited to the precise details set forth. Rather, various modifications may be made in the details within the scope and range of equivalents of the claims without departing from the spirit of the invention.